

## RESEARCH HIGHLIGHTS

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Technical Series

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SERVICE LIFE OF MULTI-UNIT RESIDENTIAL  
BUILDING ELEMENTS AND EQUIPMENT

## Introduction

Maintaining multi-unit residential buildings requires significant investment by the building owner throughout the life of the building. Estimating the reserve funds that will be needed to repair or replace building elements presents many challenges. A limited amount of theoretical information has been available to help residential building owners anticipate how the components will perform in relation to their quality, usage and life span. However, it was questionable whether the theoretical information was close enough to real life situations to be useful in accurately planning for reserve funds.

Canada Mortgage and Housing Corporation initiated a project to:

- determine real life information on the length of service life of key building elements and equipment in residential buildings;
- identify the most important factors that affect the life of the components;
- demonstrate a range of annual reserve fund contribution rates using various scenarios; and
- develop practical tools that will enable building owners to look at elements in a specific building to generate an annual cash flow and cash reserve report.

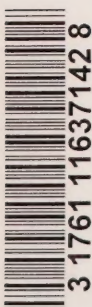
## Research Program

An essential part of the project was to gather real life data about building component life spans. Fifty-four experienced apartment building managers and building professionals participated in the study. The respondents represented public, non-profit and private sector housing across Canada.

The participants completed two questionnaires:

1. **Stage 1 questionnaire.** Respondents entered estimates for low and high-end length of service life and selected from factors that affected service life—design details; quality of materials; installation and workmanship; knowledge and understanding of building superintendent or operator; local climate and exposure to weather; regular maintenance and repairs; occupancy characteristics; and "some other factor".
2. **Stage 2 questionnaire.** The averages from the first questionnaire were circulated to the same respondents. Each person was asked to compare their first responses with the average and given the chance to adjust their response from the first round.

The next part of the project determined the present value for building elements that were identified in the survey. A recently completed condominium apartment building was selected as a model building to illustrate





**Table 1: Sample Section From the Questionnaire**

Ref. No.	Building Element	Material or Equipment Type	Your Estimate of How Long the Building element will Last	Please Check If No Opinion	Your Opinion on the 2 Most Important Factors Affecting How Long the Building Part will Last (Ref. List Below)								Please Check If No Opinion
2.4	Exterior Walls	Stucco	_____ to _____ years		A	B	C	D	E	F	G	H	
2.5	Balcony Decks	Concrete	_____ to _____ years		A	B	C	D	E	F	G	H	
2.6	Concrete Topping/Waterproofing		_____ to _____ years		A	B	C	D	E	F	G	H	

Factors Affecting Length of Service Life

A = Design Details

B = Quality of Materials

C = Installation & Workmanship

D = Knowledge & Understanding of Building Superintendent/Operator

E = Local Climate/Exposure to Weather

F = Regular Maintenance & Repair

G = Occupant Characteristics (Seniors/Families)

H = Some Other Factor

estimated replacement costs and present values of capital funding requirements.

The final part of the project was to conduct a financial analysis for reserve fund requirements using the present values. Scenarios were developed using six variables-length of service life (high-end, low end); building life span (100 years, 40 years); and construction inflation rate (3%, 5%).

## Results

### Life Span of Building Elements and Related Factors

The appendices in the report list the results of the survey on building element life span and related factors. Average service life ranges have been divided into three sub-ranges—below average, average and above average. These ranges will be helpful to managers for estimating cash flows and calculating the annual reserve fund contributions. The study team suggests that managers choose a service life length in the mid-point of the sub-range.

### Comparison with the Ontario Housing Corporation (OHC) Life Expectancy Tables

Another table compares 182 of the 232 study elements with life expectancy information developed by the OHC.

The comparison shows that the median service life indicated by the study participants is higher than the OHC expectancies for 66 per cent of the elements.

Twenty-five per cent of the elements have a greater low-end service life than shown in the OHC table.

### Sensitivity of Annual Reserve Fund Requirements

The analysis using the model building demonstrates the sensitivity of the required cash flow for multiple factors:

- length of useful life of the elements and equipment;
- assumed life of the building as a whole;
- assumed rate for construction cost inflation;
- rate of return on the unused balance in the reserve fund; and
- interest rate on loans needed to top up the reserve fund for those years where the reserve fund balance falls below zero in the course of carrying out required capital repairs and replacements.

The report concludes that a building owner should assume a relatively long building life (40 to 100 years) in order to generate sufficient capital and avoid significant shortfalls in the reserve fund. It is also worthwhile to make design and maintenance decisions that result in high-end (long) element service life. This combination requires the lowest annual contributions.

### Automated Spreadsheet

The report presents an automated spreadsheet to assist building owners in calculating reserve fund contributions.



To use the spreadsheet, the building owner:

- enters the replacement costs for the various elements applicable to a specific building; and
- selects an appropriate length of life for the building, the estimated construction inflation rate, the rate of return on the invested balance in the reserve fund and a discount rate.

The spreadsheet computes the present value of the capital requirements over the building life, taking into account the rate of return on the unused balance in the reserve fund, construction inflation rate and the discount rate. This computation gives the user the amount of the annual contribution needed to provide for sufficient funds for capital repairs over the life of the building.

**Table 2: Sample Section From the OHC Comparison Tables**

Ref. No.	Building Element	Material or Equipment Type	Service Life Low End Average (Yrs.)	Service High Low End Average (Yrs.)	Median Service Life (L+H)/2 (Yrs.)	Ontario Housing Corporation Life Expectancy* (Yrs.)
2.4	Exterior Walls	Stucco	17	25	21	20
2.5	Balcony Decks	Concrete	21	29	25	n/a
2.6	Concrete Topping/Waterproofing		12	20	16	n/a

**Table 3: Annual Cash Flow of Model Building HIGH END Average—(40 YEARS Building Life/Analysis Cutoff at Year 35)**

Ref. No.	Building Element	Material or Equipment Type	Service Life (Yrs.)	Bldg. Component Element Equipment Cost/ Dwelling Unit (1999 \$)	1	20	25	29	30	31	32	33	34	35
2.04	Exterior Walls	Stucco	25	\$428	\$0	\$0	\$1,449	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2.05	Balcony Decks	Concrete	29	\$175	\$0	\$0	\$0	\$720	\$0	\$0	\$0	\$0	\$0	\$0
2.06	Balcony Decks	Concrete Topping/ Waterproofing	20	\$60	\$0	\$159	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		1. Escalation of Annual Contribution	0.05	Per Annum	1.05	2.65	3.39	4.12	4.32	4.54	4.76	5.00	5.25	5.52
		2. Beginning Balance			\$0	\$29,492	\$31,271	\$13,048	\$13,787	-\$2,162	\$436	-\$1,957	-\$2,971	-\$2,771
		3. Contribution at the Beginning of the Year		817	\$858	\$2,168	\$2,767	\$3,363	\$3,531	\$3,708	\$3,893	\$4,088	\$4,292	\$4,507
		4. Expenditure in Current Year			\$0	-\$302	\$7,213	-\$3,404	-\$19,358	-\$1,135	-\$6,175	-\$4,933	-\$3,935	-\$1,655
		5. Interest at	0.06	Per Annum	\$51	\$1,881	\$1,609	\$780	-\$122	\$25	-\$111	-\$168	-\$157	\$5
		Closing Balance at Year	35		\$86,01	\$909	\$33,239	\$28,434	\$13,787	-\$2,162	\$436	-\$1,957	-\$2,971	\$86



## Implications for the Housing Industry

The report tables and the automated spreadsheet are important tools for building managers to use for projecting replacement activities and cash flow needs for both existing and new buildings.

For new buildings, the versatile tables will assist building managers in making judgments about service life in relation to the various factors; select an appropriate range of service life; and decide on how long to project replacement activities. The replacement time frame can relate to the remaining years of useful life of the building or a planned disposal date.

The tables are equally useful when assessing the situation for existing buildings. However, the remaining service life for each element will have to be determined through a thorough inspection and assessment of the building or a detailed review and evaluation of building repair and replacement records.

Once this information is established, the owner can calculate the cash flow needs and the annual reserve fund contributions.

The automated spreadsheet streamlines the manual process, makes it relatively easy to test varying scenarios and produces a clear summary of the annual contribution required to attain a specific scenario.

Using the tools from this study will enable building owners and managers to:

- make better decisions about repair and replacement of building elements;
- have a better understanding about the effort needed to preserve residential buildings;
- have better control of cash flow; and
- establish adequate reserve funds.

Having ample reserve funds and a better understanding of the repairs and replacements that will be needed in a particular building is a positive step toward ensuring a long and useful life for Canadian multi-unit housing stock.

**Project Manager:** Ken Ruest

**Research Reports:** *Service Life of Multi-Unit Residential Building Elements and Equipment*

**Project Consultants:** IBI Group, and Helyar and Associates

### Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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